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Physical therapy protocol for obese adolescent girls with polycystic ovarian syndrome: a within-subject design

Physical therapy protocol for obese adolescent girls with polycystic ovarian syndrome

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Abstract

Aim: In this study, we aimed to explore the effect of a suggested physical therapy protocol on the anthropometric parameters and hormonal profile of obese adolescent girls with polycystic ovarian syndrome (PCOS). Material and Method: Twenty obese adolescent girls with PCOS participated in this study. Their ages ranged from 14 to 18 years and their body mass index (BMI) ranged from 30 to 35 kg/m2. They received a specific diet therapy connected with a program of aerobic exercise for 6 months. Anthropometric parameters and serum luteinizing hormone (LH) and follicle-stimulating hormone (FSH) levels were measured before starting the study, after 3 months and after 6 months of the suggested physical therapy protocol. Results: There was a statistically highly significant reduction in the anthropometric parameters and LH/FSH ratio in the post 6 months of treatment compared with the pre-treatment and post 3 months of treatment ($p<0.01$). Also, there was a statistically highly significant reduction in the anthropometric parameters ($p<0.01$), while there was a statistically significant reduction in the LH/FSH ratio in the post 3 months of treatment compared with the pre-treatment ($p<0.05$). Discussion: The suggested physical therapy protocol for obese adolescent girls with PCOS is optimal for improving their anthropometric parameters and hormonal profile.

Keywords

PCOS; Physical Therapy; Diet; Aerobic Exercise; Obesity; Adolescent Girls; Anthropometric Parameters; LH/FSH Ratio

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Introduction

Polycystic ovarian syndrome is a complex, multifactor, heterogeneous disorder that affects 4% to 18% of reproductive-aged women [1], typically presents during adolescence [2] and is associated with reproductive, metabolic and psychological dysfunctions [1].

Polycystic ovarian syndrome is caused by a hormonal disturbance that has a role in ovulation. Its biochemical profile includes high levels of circulating free testosterone, LH/FSH ratio, estrogen and insulin with reduced levels of sex-hormone binding globulin (SHBG) [3, 4].

Adolescent obesity is prevalent worldwide [5]. There is a major association between PCOS and obesity, in a way that the mean of obesity among women with PCOS is higher than the mean of obese women without PCOS [6]. About 50% of women with PCOS suffer from obesity, especially abdominal obesity [7, 8]. Since the menstrual function is dependent on BMI, obese women with PCOS have greater ovulatory dysfunction and menstrual irregularity when compared to non-obese women [9, 10].

Weight reduction is the first recommendation in PCOS patients since it causes lowering of insulin and androgens, as well as the rise in SHBG [11]. The weight loss is usually able to correct the changed physiology of the body and resume regular ovulatory function. Ideally, a woman should reach a BMI of less than 27 kg/m2, which will induce ovulation and increase pregnancy rates [12].

Accordingly, lifestyle modification should be chosen as the first line of treatment for overweight or obese women with PCOS to promote weight loss and improve reproductive outcomes [13].

Although previous research had examined the effect of lifestyle interventions on the anthropometric parameters and hormonal profile of women with PCOS [1, 13-17], few studies have addressed this question in adolescent girls suffering from PCOS. Therefore, the aim of this study was to investigate the effect of a suggested physical therapy protocol (specific diet therapy connected with a program of aerobic exercise) on the anthropometric parameters and hormonal profile of obese girls with PCOS.

Material and Method

The study was designed as a within-subject design. The institutional review board at the Faculty of Physical Therapy, Cairo University approved this study before its commencement. The study has followed the Guidelines of the Declaration of Helsinki on the conduct of human research. The study was conducted between March 2017 and March 2018. The samples of twenty obese adolescent girls were recruited from a private center, Cairo, Egypt. They were enrolled and assessed for their eligibility to participate in the study. The participants included in the study were chosen among adolescent obese girls suffering from PCOS. They should have two of the 3 features of Rotterdam criteria for the diagnosis of PCOS which include oligo- or anovulation, clinical and/or biochemical signs of hyperandrogenism (i.e. hirsutism, acne, male pattern balding, elevated serum androgens), and polycystic ovaries on ultrasound; other etiologies should be excluded [18]. The girls' age ranged from 14 to 18 years and their BMI ranged from 30 to 35 kg/m2. The participants with a constitutional delay of puberty, hyperprolactinemia, androgen-secreting neoplasia, thyroid dysfunction, Cushing's syndrome, ovarian tumor, and malignancy were excluded. All adolescent girls did not receive any medical therapy for treating PCOS or for weight reduction.

All adolescent girls with PCOS received a suggested physical therapy protocol (specific diet therapy connected with a program of aerobic exercise) for 6 months.

Specific diet therapy

All adolescent girls were instructed to follow a specific diet therapy for 6 months. They received a low-calorie diet of 1200 Kcal/day for 3 days/week followed by a very low-calorie diet of 800 Kcal/day for the rest 4 days in the week and this diet therapy was repeated for 6 months. The calories were divided into small frequent meals with maintaining a well-balanced diet, including 55% carbohydrates, 30% fat and 15% proteins.

Aerobic exercise program

Each adolescent girl participated in an aerobic exercise program for 3 sessions a week for 6 months. Each exercise session consisted of 3 stages. The warm-up stage started with pedaling on an electronic bicycle ergometer (UNIVERSAL, made in New York, USA) at a speed of 60 revolutions per minute without load for 5 minutes. The active stage consisted of 30 minutes of pedaling at a speed of 60 revolutions/minute with load adjusted to achieve 60% of the predictive age maximal heart rate. The maximal heart rate was calculated by subtracting the age from 220. The program terminated with 5 minutes cool downstage on the electronic bicycle ergometer, during which each girl was instructed to pedal at a speed of 60 revolutions per minute without load [19].

Outcome Measures

Anthropometric parameters:

The weight-height scale was used to measure the weight and height of each adolescent girl before and after the protocol. Then, BMI was calculated by dividing weight by height squared (Kg/m2). In addition, the waist-hip ratio was calculated after measurement of both waist and hip circumferences. The waist circumference was measured when the tape measure was positioned horizontally just above the iliac crest and exactly under umbilicus, while the hip circumference was measured at the maximum circumference of the buttocks by a tape measure.

LH/FSH ratio:

Blood samples were collected from each adolescent girl to measure the levels of the circulating LH and FSH. They were collected, following overnight fasting, at 10.00 a.m. to avoid the hormonal diurnal variation. The levels of LH and FSH were analyzed by Enzyme-Linked Immunosorbent Assay (ELISA). A microplate reader (MRX) made in USA with DYNEX technologies, with serial number ICXD3442 and par code number 052100119 was used to measure hormonal levels.

Statistical analysis

All statistical measures were performed using the Statistical Package for Social science (SPSS) program version 20 for Windows. The current test involved one independent variable the measuring periods; within-subject factor which had three levels (pre and post 6 months of treatment and post 6 months).

In addition, this test involved three tested dependent variables (weight, waist/ hip ratio, and LH/FSH ratio). So, repeated measure MANOVA was used to compare the weight, waist/ hip ratio and LH/FSH ratio at different measuring periods. There were no outliers and the data were normally distributed, as assessed by boxplot and Shapiro-Wilk test ($p > .05$), respectively. The assumption of sphericity was violated, as assessed by Mauchly's test of sphericity, $x2(2) = 7.244$, $p = .027$ for weight, $x2(2) = 3.049$, $p = .218$ and, $x2(2) = 10.913$, $p = .004$ for LH/FSH ratio. Therefore, a Greenhouse-Geisser correction was applied (epsilon $\varepsilon = 0.742$) for weight and (epsilon $\varepsilon = 679$) for LH/FSH ratio to correct the one-way repeated measures MANOVA. P value ≤ 0.05 was considered significant and < 0.01 was considered highly significant.

Results

As indicated by the repeated measures MANOVA, there was a statistically highly significant difference in weight, waist/ hip ratio, and LH/FSH ratio among the three measuring periods (pre and post 3 months of the treatment, and post 6 months) ($F= 162.137$, $p < .0001$, partial $n2 = 0.0001$*). A Bonferroni multiple comparison tests (Post-hoc tests) revealed that there was a statistically highly significant reduction in the weight, waist/ hip ratio, and LH/FSH ratio at6 months post-treatment compared with the pre-treatment and at 3 months post-treatment ($p<0.01$). Also, there was a statistically highly significant reduction in the anthropometric parameters ($p<0.01$), while there was a statistically significant reduction in the LH/FSH ratio at 3 months post-treatment compared with the pre-treatment ($p<0.05$) (table 1).

Discussion

Polycystic ovarian syndrome is a complex heterogeneous disorder that commonly manifests during adolescence. Early detection and management of this syndrome are crucial to prevent its long-term negative consequences on the reproductive and metabolic systems [20]. However, little is known about the effect of lifestyle interventions on obese adolescent girls with PCOS. Therefore, this study was conducted to examine the effect of a suggested physical therapy protocol (specific diet therapy connected with a program of aerobic exercise) on the anthropometric parameters and hormonal profile of obese adolescent girls with PCOS.

Regarding the anthropometric parameters, results showed a highly significant reduction in the weight and waist-hip ratio at 6 months post-treatment compared with the pre-treatment and at 3 months post-treatment. Also, there was a highly significant reduction at 3 months post-treatment compared with the pre-treatment. These results were consistent with Abd Elmenim and Emam [21] who reported a highly significant reduction in the anthropometric parameters of girls with PCOS after 1 year of lifestyle changes. They explained the highly significant reduction in the anthropometric parameters by the fact that most of the girls wish to maintain a good body image and to conceive in the future. Therefore, they have been motivated to adhere to the program.

Additionally, the results of this study agreed with a recent systematic review and meta-analysis, which studied the effect of lifestyle interventions (exercise and diet) on clinical measures of women with PCOS. It reported that a combined exercise and dietary program, lasting more than 20 weeks, may result in a significant improvement of body composition parameters (weight, BMI, waist circumference, waist-hip ratio and body fat percentage) [14]. Moreover, a Cochrane review by Moran et al. [1] supported the results of the present study as it concluded that following a healthy diet and a regular exercise decreases body weight and improves body composition in women with PCOS.

Furthermore, many studies had investigated the beneficial effects of the combination of exercise and diet together on promoting weight loss and improving body composition in overweight and obese women with PCOS [13, 17]. These beneficial effects could be attributed to the effect of exercise and dietary control on increasing the energy expenditure more than the energy intake [22]. The addition of exercise to dietary management induces the fat mass reduction while preserving lean mass [23].

On the other hand, Lass et al. [16] showed that after 1 year of lifestyle interventions, 26 obese adolescent girls with PCOS had a successful weight loss while the other 33 girls with PCOS didn't achieve a successful weight loss.

Regarding the hormonal profile, results showed a highly significant reduction in the LH/FSH ratio at 6 months post-treatment compared with the pre-treatment and at 3 months post-treatment. Also, there was a significant reduction at 3 months post-treatment compared with the pre-treatment. These findings were consistent with Lass et al. [16] who demonstrated a highly significant reduction in the LH/FSH ratio in the obese adolescent girls with PCOS who achieved a successful weight loss in contrast to the girls who didn't attain a successful weight loss. In addition, Haqq et al. [15] concluded that lifestyle interventions (exercise plus diet) have a favorable effect on improving FSH levels significantly in women with PCOS.

Table 1. Descriptive statistics (mean ± SD) and repeated measures MANOVA for the weight, waist/hip ratio, and LH/FSH ratio among three different measuring periods.

Descriptive statistics for all dependent variables

Measuring periods	Pre-treatment	Post 3 months	Post 6 months
Weight (Kg)	91.05±8.05	82.21±8.29	73.10±7.43
Waist/hip ratio	0.91±0.04	0.86±0.031	0.81±0.02
LH/FSH ratio	1.54±0.72	1.31±0.57	1.035±0.32

Univariate analysis of Repeated measures MANOVA for all dependent variables

	F-value	P-value
Weight (Kg)	241.859	0.0001 HS
Waist/hip ratio	91.489	0.0001 HS
LH/FSH ratio	18.2	0.0001 HS

Bonferroni multiple comparison tests (Post hoc tests) for all dependent variables

	Pre-treatment vs. Post 3 months	Pre-treatment vs. Post 6 months	Post 3 months vs. Post 6 months
Weight (Kg)	0.0001 HS	0.0001 HS	0.0001 HS
Waist/hip ratio	0.0001 HS	0.0001 HS	0.0001 HS
LH/FSH ratio	0.015 S	0.001 HS	0.001 HS

S $P < 0.05$ = significant, HS $P < 0.01$ = highly significant, P = Probability.

The highly significant reduction in the LH/FSH ratio could be explained by the highly significant reduction in the anthropometric parameters, including both weight and waist-hip ratio. Previous research suggests that lifestyle interventions with modest weight reduction goals of 5-10%, especially in the abdominal area, play an effective role in reversing reproductive system dysfunction and restoring ovulation and fertility in obese women with PCOS [6, 24-26].

In contrast, Vigorito et al. [27] reported no changes in hormonal profile of young women with PCOS after 3 months of combined exercise and nutritional counseling. Additionally, Bruner et al. [28] investigated the effect of exercise and nutritional counseling for 12 weeks on the hormonal profile of women suffering from PCOS. They found a slight improvement in the LH/FSH ratio, while it was statistically non-significant. The improvement in the LH/FSH ratio occurred in the absence of significant weight loss and in the presence of significant reduction of body fatness, suggesting that the improvement of body composition may be effective in lowering the metabolic dysfunction in obese women with PCOS.

The controversy among studies regarding the effect of combined exercise and dietary program on the anthropometric parameters and hormonal profile of patients with PCOS could be attributed to the variations in intensity, duration, frequency and type of exercise; the differences in dietary restriction protocols; the lack of standardization of timing of blood draws; the difference in subject's mood changes and degrees of motivation for the program.

Although the present study provides objective data with statistically significant differences, it has some limitations. First, the adolescent girls' mood changes and degrees of motivation for the suggested physical therapy program were not considered. In addition, the lack of untreated control group is te second limitation. However, it is not ethical to prevent adolescent girls with PCOS from having an actual treatment.

Conclusion

The suggested physical therapy protocol for obese adolescent girls with PCOS is an effective modality in decreasing their weight, waist-hip ratio and LH/FSH ratio.

Scientific Responsibility Statement

The authors declare that they are responsible for the article's scientific content including study design, data collection, analysis and interpretation, writing, some of the main line, or all of the preparation and scientific review of the contents and approval of the final version of the article.

Animal and human rights statement

All procedures performed in this study were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. No animal or human studies were carried out by the authors for this article.

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Conflict of interest

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